

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

1. (previously presented): A method of manufacturing an ink jet recording head which includes a plurality of nozzle orifices forming at least one nozzle row, pressure chambers each communicated with the associated nozzle orifice, pressure generating elements each generating pressure fluctuation in ink provided in the associated pressure chamber to eject an ink droplet from the associated nozzle orifice, the method comprising the steps of:

assembling the ink jet recording head;

executing a plurality of times, individual ink droplet ejections from the nozzle orifice, while varying an ejecting condition;

identifying a correlation between ejecting conditions and ejecting results based on the plurality of ink droplet ejections; and

classifying the assembled recording head into a plurality of ranks, based on the identified correlation.

2. (previously presented): The manufacturing method as set forth in claim 1, wherein the step of executing the ink droplet ejections includes the steps of:

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supplying an evaluation signal including at least an excitation element which excites the ink pressure fluctuation, and an ejection element which follows the excitation element to eject the ink droplet from the nozzle orifice; and

measuring an ejected amount of the ink droplet at plural times as the ejecting results while varying a time period between a termination end of the excitation element and an initial end of the ejection element as the ejecting conditions.

3. (currently amended): The manufacturing method as set forth in claim 2, wherein the time period includes at least:

a first time period which is determined such that the ejected ink amount becomes minimum when ~~[[the]]~~ a natural period is as per a designed criterion;

a second time period which is shorter than the first time period; and

a third time period which is longer than the first time period.

4. (previously presented): The manufacturing method as set forth in claim 1, wherein the step of executing the ink droplet ejections includes the steps of:

supplying an evaluation signal including at least an excitation element which excites the ink pressure fluctuation, and an ejection element which follows the excitation element to eject the ink droplet from the nozzle orifice; and

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measuring an ejected speed of the ink droplet at plural times while as the ejecting results
varying a time period between a termination end of the excitation element and an initial end of
the ejection element.

5. (currently amended): The manufacturing method as set forth in claim 4, wherein the
time period includes at least:

a first time period which is determined such that the ejection speed becomes minimum
when ~~[[the]]~~ a natural period is as per a designed criterion;

a second time period which is shorter than the first time period; and

a third time period which is longer than the first time period.

6. (currently amended): The manufacturing method as set forth in claim 2, wherein
duration of the excitation element is equal to ~~[[the]]~~ a natural period as per a designed criterion
or less.

7. (currently amended): The manufacturing method as set forth in claim 6, wherein the
duration of the excitation element is equal to one half of ~~[[the]]~~ a natural period as per the
designed criterion or less.

8. (previously presented): The manufacturing method as set forth in claim 1, wherein the
plurality of ranks includes at least a first rank which indicates an actual natural period is as per a

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designed criterion, a second rank which indicates the actual natural period is shorter than the
designed criterion, a third rank which indicates the actual natural period is longer than the
designed criterion, and a fourth rank which indicates an erroneous condition.

9. (original): The manufacturing method as set forth in claim 1, further comprising the
step of indicating the classified rank on the assembled recording head.

10. (original): The manufacturing method as set forth in claim 9, wherein the classified
rank is indicated by a symbol.

11. (original): The manufacturing method as set forth in claim 9, wherein the rank is
determined with regard to the respective nozzle rows; and

wherein the rank is indicated by a symbol which indicates a combination of the classified
ranks of the respective nozzle rows.

12. (original): The manufacturing method as set forth in claim 9, wherein the classified
rank is indicated by coded information which is readable by an optical reader.

13. (original): The manufacturing method as set forth in claim 1, further comprising the
steps of:

providing a memory; and

storing electrically information indicating the classified rank in the memory.

14. (currently amended): A method of driving the ink jet recording head ~~manufactured~~
~~by the method as set forth in claim 1~~, comprising the steps of:

providing a rank indicator which indicates one of the ranks classified in the method as set
forth in claim 1;

providing a drive signal including at least one wave element having a control factor
which is defined in accordance with the ~~classified~~ rank indicated by the rank indicator; and
supplying the drive signal to the pressure generating element.

15. (original): The driving method as set forth in claim 14, wherein the drive signal is
provided with an ejection element which ejects an ink droplet from the nozzle orifice and a
damping element which follows the ejection element to damp vibration of a meniscus of the ink
in the nozzle orifice; and

wherein a control factor of the damping element is defined in the drive signal provision
step.

16. (original): The driving method as set forth in claim 14, wherein the drive signal is
provided with a characteristics changing element which changes ejection characteristics of the
ink droplet; and

wherein a control factor of the characteristics changing element is defined in the drive signal provision step.

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17. (currently amended): An ink jet recording apparatus, comprising:

an ink jet recording head, ~~manufactured~~ comprising a rank indicator which indicates one of the ranks classified by the method as set forth in claim 1; and

a waveform controller, which provides a drive signal including at least one wave element having a control factor which is defined in accordance with the classified rank.

18. (original): The recording apparatus as set forth in claim 17, wherein the drive signal is provided with an ejection element which ejects an ink droplet from the nozzle orifice and a damping element which follows the ejection element to damp vibration of a meniscus of the ink in the nozzle orifice; and

wherein the waveform controller defines a control factor of the damping element.

19. (previously presented): The recording apparatus as set forth in claim 17, wherein the drive signal is provided with a drive pulse including:

an expansion element, which expands the pressure chamber such an extent that an ink droplet is not ejected from the nozzle orifice;

an ejection element, which follows the expansion element to contract the pressure chamber to eject an ink droplet from the nozzle orifice;

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and
a holding element, which follows the ejection element to hold the contracted state of the pressure chamber for a predetermined duration; and

damping element, which follows the holding element to expand the pressure chamber to damp vibration of a meniscus of the ink in the nozzle orifice; and

wherein the waveform controller defines the duration of the holding element.

20. (previously presented): The recording apparatus as set forth in claim 17, wherein the drive signal is provided with a drive pulse including:

an expansion element, which expands the pressure chamber to pull a meniscus of ink in the nozzle orifice toward the pressure chamber;

an ejection element, which follows the expansion element to contract the pressure chamber to eject a center portion of the meniscus as an ink droplet; and

a damping element, which follows the ejection element to expand the pressure chamber to damp vibration of the meniscus; and

wherein the waveform controller defines the duration of the damping element.

21. (previously presented): The recording apparatus as set forth in claim 17, wherein the drive signal is provided with a drive pulse including:

an ejection pulse, which ejects an ink droplet from the nozzle orifice;

a damping pulse, which follows the ejection pulse to damp vibration of a meniscus of ink in the nozzle orifice; and

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a connecting element, which connects a termination end of the ejection pulse and an initial end of the damping pulse; and

wherein the waveform controller defines duration of the connecting element.

22. (previously presented): The recording apparatus as set forth in claim 17, wherein the drive signal is provided with a plurality of drive pulses for driving the pressure generating element and a connecting element which connects a termination end of a preceding drive pulse and an initial end of a subsequent drive pulse; and

wherein the waveform controller defines duration of the second connecting element.

23. (original): The recording apparatus as set forth in claim 17, wherein the drive signal is provided with a characteristics changing element which changes ejection characteristics of an ink droplet; and

wherein the waveform controller defines a control factor of the characteristics changing element.

24. (previously presented): The recording apparatus as set forth in claim 23, wherein the drive signal is provided with a drive pulse including:

an expansion element, which expands the pressure chamber such an extent that an ink droplet is not ejected; and

an ejection element, which follows the expansion element to contract the pressure chamber to eject an ink droplet from the nozzle orifice; and

wherein duration of at least one of the first expansion element and the first ejection element is defined by the waveform controller.

25. (previously presented): The recording apparatus as set forth in claim 23, wherein the drive signal is provided with a drive pulse including:

an expansion element, which expands the pressure chamber such an extent that an ink droplet is not ejected; and


an ejection element, which follows the expansion element to contract the pressure chamber to eject an ink droplet from the nozzle orifice; and

wherein a potential difference between an initial end and a termination end of at least one of the expansion element and the ejection element is defined by the waveform controller.

26. (previously presented): The recording apparatus as set forth in claim 23, wherein the drive signal is provided with a drive pulse including:

an expansion element, which expands the pressure chamber such an extent that an ink droplet is not ejected;

a holding element, which follows the expansion element to hold the expanded state of the pressure chamber; and

 an ejection element, which follows the expansion element to contract the pressure chamber to eject an ink droplet from the nozzle orifice; and
wherein the waveform controller defines duration of the holding element.

27. (previously presented): The recording apparatus as set forth in claim 23, wherein the drive signal is provided with a pulse including:

an expansion element, which expands the pressure chamber to pull a meniscus of ink in the nozzle orifice toward the pressure chamber; and

an ejection element, which follows the expansion element to contract the pressure chamber to eject a center portion of the meniscus as an ink droplet; and

wherein duration of at least one of the expansion element and the ejection element is defined by the waveform controller.

28. (previously presented): The recording apparatus as set forth in claim 23, wherein the drive signal is provided with a drive pulse including:

an expansion element, which expands the pressure chamber to pull a meniscus of ink in the nozzle orifice toward the pressure chamber; and

an ejection element, which follows the expansion element to contract the pressure chamber to eject a center portion of the meniscus as an ink droplet; and

wherein a potential difference between an initial end and a termination end of at least one of the expansion element and the ejection element is defined by the waveform controller.

29. (previously presented): The recording apparatus as set forth in claim 23, wherein the drive signal is provided with a drive pulse including:

an expansion element, which expands the pressure chamber to pull a meniscus of ink in the nozzle orifice toward the pressure chamber;

a holding element, which follows the expansion element to hold the expanded state of the pressure chamber; and

an ejection element, which follows the holding element to contract the pressure chamber to eject a center portion of the meniscus as an ink droplet; and

wherein the waveform controller defines duration of the holding element.

30. (previously presented): The driving method as set forth in claim 14, wherein the plurality of ranks includes at least a first rank which indicates an actual natural period is as per a designed criterion, a second rank which indicates the actual natural period is shorter than the designed criterion, a third rank which indicates the actual natural period is longer than the designed criterion, and a fourth rank which indicates an erroneous condition.

31. (original): The recording apparatus as set forth in claim 17, further comprising: a memory, which electrically stores information indicating the classified rank, the memory electrically connected to the waveform controller.

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32. (original): The recording apparatus as set forth in claim 17, further comprising:
a rank indicator, provided with the recording head to indicate the classified rank thereof
so as to be optically readable; and

an optical reader, which optically reads the classified rank indicated by the rank indicator,
wherein the waveform controller acquires the classified rank read by the optical reader.

33. (original): The recording apparatus as set forth in claim 17, wherein the pressure
generating element is a piezoelectric vibrator.

34. (original): The recording apparatus as set forth in claim 17, wherein the pressure
generating element is a heating element.

35. (previously presented): An ink jet recording head, comprising a rank indicator, which
indicates one of the ranks classified by the method as set forth in claim 1.

36. (original): The recording head as set forth in claim 35, wherein the pressure
generating element is a piezoelectric vibrator.

37. (original): The recording apparatus as set forth in claim 35, wherein the pressure
generating element is a heating element.

AMENDMENT UNDER 37 C.F.R. § 1.111
U.S. Appln. No. 09/942,764

38. (currently amended): The manufacturing method as set forth in claim 4, wherein duration of the excitation element is equal to ~~[[the]]~~ a natural period as per the designed criterion or less.

39. (currently amended): The manufacturing method as set forth in claim 38, wherein the duration of the excitation element is equal to one half of ~~[[the]]~~ a natural period as per the designed criterion or less.

40. (previously presented): The ink jet recording head as set forth in claim 35, wherein the classified rank is indicated by a symbol.

41. (previously presented): The ink jet recording head as set forth in claim 35, further comprising a plurality of nozzle rows;

wherein the rank is determined with regard to the nozzle rows; and

wherein the rank is indicated by a symbol which indicates a combination of the classified ranks of the nozzle rows.

42. (previously presented): The ink jet recording head as set forth in claim 35, wherein the classified rank is indicated by coded information which is readable by an optical reader.

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43. (previously presented): The ink jet recording head as set forth in claim 35, further
D) comprising a memory which electrically stores information indicating the classified rank.
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44. (new): The manufacturing method as set forth in claim 1, wherein at least one of the
ranks is associated with a plurality of correlations.
